WHAT IS CLAIMED IS:

1. A sustain-discharge driving device of a high-efficiency plasma display panel (PDP), the sustain-discharge driving device comprising:

a sustain-discharge switching unit, which connects charging and discharging paths of an energy recovery unit to the PDP, according to a sustain-discharge sequence; and

the energy recovery unit, which, according to an energy recovery sequence, discharges energy of the PDP to an energy accumulation device through a resonance path while in discharging mode, charges the PDP with the energy accumulated in the energy accumulation device through a resonance path while in charging mode, and forms a closed circuit in which a voltage difference between both ends of an inductor is greater than a predetermined value, so as to eliminate a free-wheeling current, which is generated in the inductor of the resonance path due to a parasitic effect, during mode transition.

2. The sustain-discharge driving device of claim 1, wherein the charging mode is divided into a first charging mode and a second charging mode, the discharging mode is divided into a first discharging mode and a second discharging mode, and different resonance paths are formed in the first charging mode and the second charging mode, and in the first discharging mode and the second discharging mode.

3. The sustain-discharge driving device of claim 2, wherein the energy recovery sequence is configured such that durations of the first charging mode and the second charging mode are identical to each other.

4. The sustain-discharge driving device of claim 2, wherein the energy recovery sequence is configured such that durations of the first discharging mode and the second discharging mode are identical to each other.

5. The sustain-discharge driving device of claim 2, wherein the charging mode and the discharging mode include a mode in which a path, not caused by any inductor, is formed to separate the first charging mode from the second charging mode and separate the first discharging mode from the second discharging mode.

6. The sustain-discharge driving device of claim 1, wherein the energy recovery unit includes four inductors which form resonance paths, caused by different inductors, in the first charging mode and the second charging mode, and in the first discharging mode and the second discharging mode.

7. The sustain-discharge driving device of claim 1, wherein the sustain-discharge switching unit which includes first, second, third, and fourth switches (S_{d1}, S_{d2}, S_{u2}, S_{u1}) connected in series, connects one end of the first switch to a ground line and one end of the fourth switch to a supply voltage, connects a contact point of the second switch and the third switch to the PDP, and connects a contact point of the first switch and the second switch and a contact point of the third switch and the fourth switch to different ends of the energy recovery unit.

8. The sustain-discharge driving device of claim 7, wherein the sustain-discharge sequence is configured such that the second switch is turned on and other switches are turned off in the first charging mode, and the third switch is turned on and the other switches are turned off in the second charging mode.

9. The sustain-discharge driving device of claim 7, wherein the sustain-discharge sequence is configured such that the third switch is turned on and other switches are turned off in the first discharging mode, and the second switch is turned on and the other switches are turned off in the second discharging mode.

10. The sustain-discharging driving device of claim 1, wherein the energy recovery unit comprises:

an energy accumulation device block, which has first through fourth capacitors (C_{d1}, C_{d2}, C_{u2}, C_{u1}) connected in series and connects one end of the first capacitor to a ground line and one end of the fourth capacitor to a supply voltage;

a path switching block, which is connected to the first through fourth capacitors in parallel and includes a plurality of switches (S_{r1}, S_{f1}, S_{r2}, S_{f2}) and a plurality of diodes (D_{r1}, D_{f1}, D_{r2}, D_{f2}, D_u, and D_d) for forming a current path, including different inductors (L_{r1}, L_{f1}, L_{r2}, and L_{f2}) in the first charging mode and the second charging mode, and in the first discharging mode and the second discharging mode, according to the energy recovery sequence;

a plurality of inductors connected to a plurality of switches to form resonance paths in the first charging mode, the second charging mode, the first discharging mode, and the second discharging mode; and

a plurality of diodes (D_{u1}, D_{u2}, D_{u3}, D_{u4}, D_{d1}, D_{d2}, D_{d3}, and D_{d4}), which is connected to respective both ends of the inductors, clamps voltages of the switches, and forms a path for eliminating the free-wheeling current,

wherein the energy recovery unit arranges circuit components to form a free-wheeling current flow path in which the voltage difference between both ends of the inductor is greater than a predetermined value, the free-

wheeling current generated in the resonance path caused by the inductor due to the parasitic effect in mode transition.

11. The sustain-discharge driving device of claim 10, wherein in the first charging mode, the energy recovery unit turns on a switch S_{d2} and the switch S_{r1} so that the PDP is charged with an energy accumulated in the capacitor C_{d1} through an LC resonance path of C_{d1}-S_{r1}-L_{r1}-D_{r1}-S_{d2}-C_p (C_p denotes a panel capacitor), and at end of the first charging mode, the energy recovery unit has circuit components arranged to eliminate the free-wheeling current, which is generated due to the parasitic effect, through a path of D_{d4}-L_{r1}-S_{r1}-C_{d1}.

12. The sustain-discharge driving device of claim 10, wherein in the second charging mode, the energy recovery unit turns on a switch S_{u2} and the switch S_{r2} so that the PDP is charged with energy accumulated in the capacitors C_{d1}, C_{d2}, and C_{u2} through an LC resonance path of C_{d1}-C_{d2}-C_{d3}-S_{r2}-L_{r2}-D_{r2}-S_{u2}-C_p (C_p denotes a panel capacitor), and at the end of the second charging mode, the energy recovery unit arranges circuit components to eliminate the free-wheeling current, which is generated due to the parasitic effect, through a path of D_{u4}-L_{r2}-S_{r2}-C_{u2}.

13. The sustain-discharge driving device of claim 10, wherein in the first discharging mode, the energy recovery unit turns on a switch S_{u2} and the switch S_{f2} so that energy charged in the PDP is discharged to the capacitors C_{u2}, C_{d2}, and C_{d1} through an LC resonance path of C_p-S_{u2}-D_{f2}-L_{f2}-C_{u2}-C_{d2}-C_{d1}, and at the end of the first discharging mode, the energy recovery unit arranges circuit components to eliminate the free-wheeling current, which is generated due to the parasitic effect, through a path of S_{f2}-L_{f2}-D_{u2}-C_{u1}.

14. The sustain-discharge driving device of claim 10, wherein in the second discharging mode, the energy recovery unit turns on a switch S_{d2} and the switch S_{f1} so that energy charged in the PDP is discharged to the capacitor C_{d1} through an LC resonance path of C_p-S_{u2}-D_{d2}-L_{f1}-S_{f1}-C_{d1}, and at the end of the second discharging mode, the energy recovery unit has circuit components arranged to eliminate the free-wheeling current, which is generated due to the parasitic effect, through a path of S_{f1}-L_{f1}-D_{d2}-C_{d2}.

15. A method of designing a sustain-discharge driving device of a plasma display panel (PDP) having a switching sequence that repeats reset, address, and sustain periods, wherein the sustain-discharge driving device is designed to form a free-wheeling current flow path in which the voltage difference between both ends of the inductor is greater than a predetermined

value, the free-wheeling current generated in an inductor of the resonance path due to the parasitic effect during mode transition.

16. The method of claim 15, wherein the charging mode is divided into a first charging mode and a second charging mode, the discharging mode is divided into a first discharging mode and a second discharging mode, and different resonance paths are formed in the first and second charging modes and in the first and second discharging modes.

17. The method of claim 16, wherein the energy recovery sequence is configured such that durations of the first charging mode and the second charging mode are identical to each other.

18. The method of claim 16, wherein the energy recovery sequence is configured such that durations of the first discharging mode and the second discharging mode are identical to each other.

19. The method of claim 16, wherein the charging mode and the discharging mode include a mode in which a path, not caused by any inductor, is formed to separate the first charging mode from the second charging mode and separate the first discharging mode from the second discharging mode.

20. The method of claim 16, wherein the energy recovery sequence is configured such that half of a maximum charging voltage charges the PDP in the first charging mode and the second charging mode, respectively.

21. The method of claim 16, wherein the energy recovery sequence is configured such that half of a maximum charging voltage discharges the PDP in each of the first discharging mode and the second discharging mode, respectively.

22. A plasma display panel (PDP) driving system which repeats reset, address, and sustain-discharge periods according to a switching sequence, the PDP driving system comprising:

a Y electrode sustain-discharge driving circuit, which applies a high frequency voltage of rectangular waveform to a Y electrode of the PDP, by dividing a charging mode into a first charging mode and a second charging mode, and a first discharging mode and a second discharging mode, directs the Y electrode of the PDP to be charged and/or discharged through a resonance path caused by difference inductors in the first and second charging modes, and in the first and second discharging modes, and includes a closed circuit in which a voltage difference between both ends of an inductor is greater than a predetermined value so as to eliminate a free-wheeling current, which is

generated in the inductor of the resonance path due to a parasitic effect, during mode transition;

a separation and reset circuit, which separates circuit operations, during the sustain period, from circuit operations, during other periods such as the address period and the reset period, and applies a ramp-type high voltage to the PDP during the reset period;

a scan pulse generating circuit, which applies a horizontal synchronization signal during the address period, which is shortened during the other periods; and

an X electrode sustain-discharge driving circuit, which applies a high frequency voltage of rectangular waveform to an X electrode of the PDP, by dividing a charging mode into a first charging mode and a second charging mode and dividing a discharging mode into a first discharging mode and a second discharging mode, directs the first and second charging modes, and in the first and second discharging modes to charge and/or discharge the Y electrode of the PDP through a resonance path including difference inductors, and includes a closed circuit in which a voltage difference between both ends of the inductor is greater than a predetermined value, so as to eliminate a free-wheeling current, which is generated in the inductor of the resonance path due to a parasitic effect, during mode transition.

23. The PDP driving system of claim 22, wherein the Y electrode sustain-discharge driving circuit or the X electrode sustain-discharge driving circuit comprises:

a sustain-discharge switching unit, which includes first, second, third, and fourth switches (S_{d1}, S_{d2}, S_{u2}, S_{u1}) connected in series, connects one end of the first switch to a ground line and one end of the fourth switch to a supply voltage, connects a contact point of the second switch and the third switch to the PDP, and connects a contact point of the first switch and the second switch and a contact point of the third switch and the fourth switch to different ends of the energy recovery unit;

an energy accumulation device block, which has first through fourth capacitors (C_{d1}, C_{d2}, C_{u2}, C_{u1}) connected in series and connects one end of the first capacitor to a ground line and one end of the fourth capacitor to a supply voltage;

a path switching block, which is connected to the first through fourth capacitors in parallel and includes a plurality of switches (S_{r1}, S_{f1}, S_{r2}, S_{f2}) and a plurality of diodes (D_{r1}, D_{f1}, D_{r2}, D_{f2}, D_u, and D_d) for forming a current path, including different inductors (L_{r1}, L_{f1}, L_{r2}, and L_{f2}) in the first charging mode and the second charging mode, and in the first discharging mode and the second discharging mode, according to the energy recovery sequence;

a plurality of inductors connected to a plurality of switches to form resonance paths in the first charging mode, the second charging mode, the first discharging mode, and the second discharging mode; and

a plurality of diodes (D_{u1}, D_{u2}, D_{u3}, D_{u4}, D_{d1}, D_{d2}, D_{d3}, and D_{d4}), which is connected to respective both ends of the inductors, clamps voltages of the switches, and forms a path for eliminating the free-wheeling current,

wherein the energy recovery unit arranges circuit components to form a free-wheeling current flow path in which the voltage difference between both ends of the inductor is greater than a predetermined value, the free-wheeling current generated in the inductor of the resonance path due to the parasitic effect during mode transition.